West Valley Demonstration Project

Doc. ID Number	WVDP-512
Revision Number	REV. 0
Revision Date	08/26/2010

NORTH PLATEAU PERMEABLE TREATMENT WALL PERFORMANCE MONITORING PLAN

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1.0 INTRODUCTION

West Valley Environmental Services, LLC (WVES) was directed by the U.S. Department of Energy to mitigate the spread of Strontium-90 (Sr-90) affected groundwater beneath the North Plateau at the West Valley Demonstration Project located in West Valley, New York (Figure 1; Figure 2) A permeable treatment wall (PTW) was selected to mitigate the migration of Sr-90 affected groundwater along an alignment located north of the main plant facility and hydraulically downgradient of the area of greatest groundwater impact. This Performance Monitoring Plan (Plan) was prepared by AMEC Geomatrix, Inc. (AMEC) under contract to WVES and outlines a monitoring program that will be used to evaluate the effectiveness of the PTW. This Plan meets the requirements of the Summary Design Criteria for the PTW that require the preparation of a monitoring plan that addresses the placement of wells, plans for sampling and analysis of groundwater, and provides methods to evaluate the data to determine performance of the PTW. Any monitoring plan for the PTW will be implemented fully consistent with the administrative and programmatic procedures set forth in WVDP-091–Groundwater Protection Management Program Plan, WVDP-239–Groundwater Monitoring Plan, and WVDP-190–Groundwater Monitoring Equipment Decommissioning Plan.

This Plan consists of eight sections and appendices. Section 2.0 includes background information pertaining to site hydrogeology, the distribution of Sr-90 in groundwater, and the PTW design; Section 3.0 of the Plan identifies performance monitoring objectives; Section 4.0 describes the performance monitoring network; performance monitoring activities are detailed in Section 5.0; a monitoring schedule and activities for the various monitoring events is described in Section 6.0; Section 7.0 includes data analysis and reporting; and Section 8 includes a list of references.

2.0 BACKGROUND

2.1 Subsurface Description

Sr-90 affected groundwater on the North Plateau migrates generally in a northerly direction through surficial sand and gravel deposits that overly the surface of a laterally extensive till unit (Lavery till or ULT). The surficial sand and gravel deposits are further subdivided into a thick-bedded unit (TBU) and a slack-water sequence (SWS). The TBU is a postglacial alluvial fan and the more extensive of the two deposits. The SWS is a glacial melt water deposit that contains thin-bedded layers of clay, silt, sand, and fine-grained gravel. The TBU overlies the Lavery till over most of the North Plateau and directly overlaps the older SWS that occurs in a narrow northeast-trending trough in the Lavery till (AMEC, 2009).

The lateral extent of Sr-90 affected groundwater on the North Plateau is coincident with the lateral extents of the SWS south of Lagoon 5. Near Lagoon 5, the Sr-90 plume splits into three lobes. These lobes have previously been referred to as the western, central, and eastern lobe (Figure 3). The leading edge of the western lobe migrates toward the swamp ditch. The leading edge of the recently identified center lobe extends to the central portion of the Construction and Demolition Debris Landfill (CDDL) along the orientation of the SWS. The leading edge of the eastern lobe occurs north of Lagoon 3 and southeast of the CDDL (Figure 3).

2.2 PTW Design

The groundwater remediation system selected to mitigate the migration of Sr-90 affected groundwater consists of an approximately 850-foot long hydraulically passive permeable treatment wall of granular zeolite. The alignment selected for the PTW is located north of the main plant facility and hydraulically downgradient of the area of greatest groundwater impact (Figure 4). The PTW will intersect both the TBU and SWS and be keyed into the underlying ULT with the intent of fully capturing the vertical extent of Sr-90 affected groundwater. The functionality of the PTW system is based on the capacity of the zeolite to preferentially sorb Sr-90 cations, displacing other cations on the molecular structure of the mineral through an ion exchange process. Although Sr-90 (a divalent cation) in site groundwater will be exchanged for monovalent cations (such as sodium and potassium) within the zeolite structure, naturally occurring divalent cations (such as calcium and magnesium) also will compete for these sites. Additional details related to the PTW design are included in the West Valley Thirty Percent Design Report – North Plateau Permeable Treatment Wall (AMEC, 2009).

A detailed soil boring program was completed in February 2010 along the proposed PTW alignment. The program included the advancement of 37 soil borings to ULT surface. Soils were field screened for radioactivity using a Geiger Muller unit. Temporary well screens were used to collect groundwater samples that were subsequently analyzed for Sr-90. Soil boring locations are depicted in Figure 5. The results of this investigation, including geologic interpretation, Geiger count readings, and groundwater sampling results are summarized in cross section view in Figure 6.

3.0 PERFORMANCE MONITORING OBJECTIVES

The general objectives of the performance monitoring program will be to:

1. Monitor the physical integrity of the PTW and its components.
2. Assess the movement of Sr-90 affected groundwater in the vicinity the PTW.
3. Monitor and assess the removal of Sr-90 from groundwater moving through the PTW.

The overall objective of the performance monitoring program will be to evaluate whether the functional requirements for the PTW are being met. Eight functional requirements were developed for the PTW based on the Remedial Action Objectives for the site (AMEC, 2009). The functional requirements are:

1. Create a sorption barrier (PTW) that limits the expansion of groundwater impacted by Sr-90 at or above the 10,000 pCi/L level. Due to constructability issues, the PTW will not be designed to address groundwater impacted at or above the 10,000 pCi/L level that has migrated below and west of the Construction and Demolition Debris Landfill.

2. Sr-90 contamination levels in groundwater passing through the PTW should demonstrate an overall stable or downward trend (compared to upgradient levels) over time to support an objective of substantially reducing plume expansion.

3. Sr-90 contamination should not be redirected to currently less-contaminated areas.

4. Groundwater flow through the PTW should be sufficient to preclude substantial changes in groundwater flow patterns that would require additional mitigation actions.

5. The PTW shall be keyed into the underlying competent aquitard (unweathered Lavery till unit) a minimum of one foot along the PTW alignment.

6. Groundwater monitoring shall be maintained around the PTW. Proposed modifications to the existing monitoring network will be evaluated and approved by Environmental Affairs.

7. Design should not preclude any strategies for further addressing Sr-90 plume during decommissioning.

8. Expended PTW material (e.g., zeolite) must be able to be removed if required in the future.

Functional Requirement 1, 2, 3, and 4 can be evaluated using the performance monitoring program identified in this document. Functional Requirement 5, 7, and 8 are addressed through the PTW design process and quality assurance/quality control during PTW construction. Functional Requirement 6 is addressed by implementation of a performance monitoring program similar to the one detailed in this Plan. After the performance monitoring program and associated data analysis are described in greater detail in Section 6.0 and 7.0, individual components of the performance monitoring program are related back to one or more of the functional requirements to describe in greater detail how performance monitoring will be used to evaluate functional requirements for the PTW.

4.0 PERFORMANCE MONITORING NETWORK

4.1 Performance Monitoring Locations

The PTW performance monitoring system will consist of a network of existing groundwater monitoring wells, and new wells that are to be installed as part of the PTW implementation program. The existing monitoring network for the North Plateau Sr-90 plume is shown in Figure 7. A subset of monitoring wells from the existing network will be incorporated into this Plan to assess the movement of Sr-90 impacted groundwater in the vicinity of the PTW. Monitoring wells in each of the three plume lobes are incorporated into the Plan. Additional wells are incorporated into the Plan to monitor groundwater conditions between the three plume lobes. These wells are identified in Figure 7.Twelve monitoring stations will be installed on the PTW installation platform in addition to existing wells[1]. Each station will consist of three monitoring locations installed as a transect oriented perpendicular to the PTW alignment. Monitoring locations will be installed at the southern edge of the installation platform to assess influent groundwater conditions; within the PTW to assess groundwater conditions inside of the PTW; and at the northern edge of the installation platform to assess presumed effluent groundwater conditions. Monitoring stations will be installed within each of the three Sr-90 plume lobes to monitor segments of the wall that are expected to experience comparatively larger Sr-90 loading. Additional stations will also be installed between the plume lobes. Monitoring stations are depicted in plan and cross section view in Figure 8. Monitoring wells will also be installed at the two ends of the PTW to assess groundwater conditions in these areas (Figure 8).

Monitoring locations where both the SWS and TBU are present will be installed as well couplets consisting of collocated wells screened in each respective unit. Well couplets will also be installed in portions of the wall characterized by larger saturated thicknesses. Well couplets will provide additional information regarding vertical gradients and the vertical distribution of Sr-90. Well couplet locations are depicted in plan and cross section view in Figure 8.

Well clusters, consisting of four (4) collocated small-diameter monitoring wells, will be installed at two locations within the PTW. The screened intervals of the cluster wells will be positioned vertically to provide higher resolution information regarding vertical gradients within the PTW. Cluster well locations are depicted in plan view in Figure 8 and in cross section view in Figure 8. Figure 8 also includes a conceptual three dimensional rendering of a portion of the performance monitoring network.

The single pass trenching machine that will install the PTW cannot vary the installation depth of the PTW at rate (or slope) equal to the elevation changes in the till surface. The trenching machine will be required to trench through a number of small ‘hills’ in the till unit to ensure that the PTW is adequately keyed into the underlying till. The base of the PTW is depicted in cross section view in Figure 8. As shown in Figure 8, five small higher elevation areas in the till unit (till hills) will be trenched through. Trenches of higher permeability material (i.e., zeolite) present in the till hills could potentially create a conduit for lateral flow within the PTW. Alternatively, these higher permeability trenches in the till hills could function as stagnation zones with little to no lateral flow. Monitoring wells will be installed within the PTW at locations where the PTW intersected a till hill to evaluate the potential for lateral groundwater flow. Local velocities in the vicinity of these wells will be evaluated using the techniques described below in Section 5.2. Depending on the results of hydraulic testing (that is, if substantial lateral flow was occurring), these wells will be incorporated into routine sampling events. Conversely, if hydraulic testing indicated the higher permeability trenches through the till hills were functioning as stagnation zones, then the wells will remain in place but not be incorporated into routine

[1] The installation platform is the approximately 15-foot wide working platform that will be constructed for the single-pass trenching machine that will install the PTW.

sampling events. By remaining in place the wells could be used for specialty or contingency monitoring at a later date if appropriate. Monitoring well locations are shown in Figure 8.

Newly installed monitoring wells on the PTW installation platform will collectively be referred to in this Plan as “PTW wells”. The entire performance monitoring network, which will consist of newly installed wells on the PTW installation platform and existing monitoring wells identified in Figure 7, will collectively be referred to as “full network” (Figure 8).

4.2 Monitoring Well Construction and Development

4.2.1 Monitoring Well Construction within PTW

The permeability of the zeolite treatment media is expected to be greater than the permeability of sand sizes typically used in the construction of filter packs. A filter pack will not be constructed for monitoring wells installed within the PTW (intra-wall wells). Instead, the zeolite treatment media will be allowed to naturally collapse around the well. Well assemblies for intra-wall wells will consist of 2.0-inch diameter Schedule 40 PVC with 0.020-inch slot size. A slightly larger slot size was selected for the intra-wall wells to account for the greater permeability of the zeolite treatment media. Well screen lengths will be either 5-feet or 10-feet depending on the thickness of the TBU or SWS at each location. The well assembly for the two well clusters used to monitor vertical gradients within the PTW will consist of 0.75-inch diameter Schedule 40 PVC with 0.020-inch slot size. Well screen lengths will be 3-feet.

Intra-wall wells will be installed by advancing direct push probe rods to the desired depth. The well assemblies will be lowered into the rod string using threaded Schedule 40 riser pipe. The rod strings will slowly be retracted to a point approximately three feet below ground surface. A 1-foot thick sand barrier will then be installed on top of the zeolite treatment media. A minimum of 2-feet of bentonite seal will be placed above the sand pack. Wells will be completed with “stick-up” protective outer casings so the wells can be more easily located during the winter months. The stick-up casings would also provide another means of alerting construction workers to the presence of the PTW, thereby helping to prevent inadvertent excavation into the PTW at a future date.

4.2.2 Monitoring Well Construction Outside PTW

The well assemblies for wells installed outside of the PTW will consist of 2.0-inch diameter Schedule 40 PVC with factory installed 0.7-inch filter packs. The factory installed filter pack will consist of 20/40 sand wrapped in a stainless steel mesh. The outside diameter of the well assembly, which includes the well casing and factory installed filter pack, will total 3.4-inches. Well screen lengths will be either

5-feet or 10-feet depending on the thickness of the TBU or SWS at each location. The slot size for the well screens will be 0.010-inches.

Monitoring wells will be installed by advancing direct push probe rods to the desired depth. The well assemblies will be lowered into the rod string using threaded Schedule 40 riser pipe. After the well assembly has been lowered to the target depth, the rod string will be retracted to a point just above the top of the factory installed filter pack. A 1-foot thick sand barrier will then be installed immediately above the factory installed filter pack. A minimum of 2-feet of bentonite seal will be placed above the sand pack. The remaining annular space between the bentonite seal and the ground surface will be grouted with a cement-bentonite mixture. Monitoring wells installed outside of the PTW will also be completed with “stick-up” protective outer casings.

4.2.3 Monitoring Well Development and Surveying

Monitoring wells will be developed in accordance with *EM-519 – Monitoring Well Development.* Following installation, monitoring wells will be surveyed by a State of New York licensed surveyor. Surveyed well attributes will include northing and easting in the State Plane coordinate system along with the elevation of ground surface, the top of the protective outer casing, and the top of the PVC riser pipe.

5.0 PERFORMANCE MONITORING

Performance monitoring for the PTW will consist of three components:

1. Visual inspections to monitor the physical integrity of the PTW and its components.
2. Hydraulic monitoring to assess the movement of Sr-90 affected groundwater in the vicinity of the PTW.
3. Groundwater quality monitoring to assess the treatment performance of the PTW.

5.1 Visual Inspections

Within 3 months of PTW installation, baseline visual conditions will be documented (photographs, etc) to provide the basis for the following subsequent visual inspections.

Visual inspections of the PTW area will be conducted during each monitoring event (Table 1). The objective of site inspections is to detect changes in ground surface, land use, construction, etc., that may indicate a physical change in the PTW.

During each monitoring event, a visual inspection of the ground surface along the PTW alignment will be performed. If changes in the ground surface are observed, such as local depressions or mounds, the location and description of the feature(s) will be documented and reported. New landscaping, utilities, or any other physical or operational changes that could potentially affect the physical integrity of the PTW will also be reported. Visual inspections will also evaluate potential seepage faces that could be indicative of groundwater discharging to land surfaces in the vicinity of the PTW. If groundwater seepage to land surface is identified, a surface water sample will be collected and submitted for laboratory analysis of Sr-90.

Visual inspections of storm water infrastructure in the vicinity of the PTW will also be conducted during PTW performance monitoring events. The objective of the visual inspections is to identify damage to the drainage network or physical obstructions within the drainage network that could potentially lead to increased storm water infiltration in the vicinity of the PTW. Visual inspections will evaluate the following:

- Debris that may have collected in the drainage channel(s) and is potentially restricting flow.

- Debris that may have collected at entrances to catch basins and may be restricting flow.

Debris that has collected in the drainage swale or at catch basin inlets will be removed, if practical, in conjunction with the visual inspection. If debris cannot be removed upon identification then the debris will be noted on the PTW inspection form and flagged for follow up action.

Erosional channels, depressions, or other surface features identified during the inspection that could potentially lead to increased infiltration in the vicinity of the PTW will be filled and graded as appropriate.

Inspection results and any repairs or maintenance conducted as a result of inspections will be documented in PTW performance monitoring reports. PTW performance monitoring reports will be prepared annually in conjunction with the groundwater monitoring reports that are currently prepared for the site.

A copy of an example PTW Inspection Form has been included as Attachment A. This form is provided as an example template and should be modified or updated to correspond to the final as-built site conditions following PTW installation.

5.2 Hydraulic Monitoring

Hydraulic monitoring activities are summarized below. Additional details regarding the frequency and locations (i.e., which monitoring wells) of these activities, and data analysis methods, are provided in the following sections.

- Water Level Measurements – Depth to groundwater measurements will be collected with a water level meter during sampling events. For the first year of PTW system operation water level measurements will be measured on a monthly basis. Water level measurements will be collected in accordance with EM-6 Groundwater Sampling.
- In Situ Hydraulic Conductivity Testing – In situ hydraulic testing will be conducted to estimate hydraulic conductivities (e.g., permeability changes) in the vicinity of performance monitoring wells. In situ hydraulic conductivity testing will be conducted in accordance with EMP-521. In Situ Hydraulic Conductivity Testing.
- Well Tracer Dilution Tests – Well tracer dilution tests (i.e., dilution tests) will be conducted to estimate localized velocities in the vicinity of each monitoring well. Dilution tests provide a direct measurement of groundwater flow rates within a single well without the need to estimate hydraulic conductivities or gradients (Hall, 1993; Halevy et al., 1967). During the dilution test, groundwater within the well (the 'test interval') is continuously mixed by extracting and reinjecting groundwater with a peristaltic pump. A concentrated sodium bromide solution (or other tracer) is slowly metered into the recirculating groundwater to establish an initial dissolved bromide concentration between 100 and 200 milligrams/liter in the test interval. After the bromide tracer has been introduced to the test interval, changes in bromide concentrations are monitored over time using a hand-held ion specific electrode. The rate at which the tracer concentration decreases in the test interval is a function of the flow through the well and can be used to estimate groundwater velocity.
- Pressure Transducer Monitoring – Pressure transducers will be installed in a subset of wells located within the PTW during the first year of PTW system operation to monitor hydraulic responses to rainfall events and snowmelt. The transducers will both measure and record hydraulic pressure changes at a regular interval (e.g., seconds, minutes, hours) defined by the user. The transducers, recorder, and its power supply (internal battery) are installed completely within the well with data downloaded to a portable computer as needed. After installation, the transducers will be calibrated against hand measurements using a water level meter. After the initial calibration the transducers will be checked again daily for the first week and then weekly for the remainder of the first month. Data will be downloaded from the transducers on a monthly basis.

5.3 Groundwater Quality Monitoring

Groundwater quality monitoring activities are summarized below. Additional details regarding the frequency and locations (i.e., which monitoring wells) of these activities, and data analysis methods, are provided in the following sections.

- Strontium-90 Sampling – Groundwater sample collection from performance monitoring wells and subsequent laboratory analysis for Sr-90.
- Geochemical Sampling – Groundwater sample collection from the performance monitoring wells and subsequent laboratory analysis for major cations and anions (sodium, potassium, calcium, magnesium, carbonate, bicarbonate, sulfate, and chloride).
- Field Parameters – Standard field parameters will be measured during groundwater sampling with flow through cells or other field instruments and include temperature, pH, oxidation-reduction potential, specific conductance, dissolved oxygen, and turbidity. [Although these parameters are not directly related to monitoring the

- performance of the PTW, results will be utilized to identify overall conditions in the groundwater. Changes to such conditions may occur during future site decommissioning activities (e.g., upgradient excavations, etc,]

All groundwater sampling activities will be conducted in accordance with *EM-6 Groundwater Sampling* and *EM-52 Environmental Sample Receipt, Handling, Storage, Packaging, and Shipment*.

6.0 PERFORMANCE MONITORING EVENTS

Performance monitoring events consist of:

- initial baseline monitoring,
- routine monitoring,
- supplemental hydraulic monitoring
- annual monitoring, and
- 5-year comprehensive monitoring.

The initial baseline monitoring will be a comprehensive baseline evaluation of hydraulics and groundwater chemistry within and adjacent to the PTW. The initial monitoring event will generate baseline hydraulic and chemistry data that subsequent monitoring data will be compared against. Routine monitoring events will be conducted over the operational lifetime of the PTW and consist primarily of water level measurements and sampling for Sr-90 in PTW wells.

Routine monitoring events will be completed on a quarterly basis during the first two years of PTW system operation. A reduced monitoring frequency could potentially be proposed after the first two years of quarterly monitoring if monitoring data indicates temporal variability can be adequately captured using a reduced monitoring frequency (e.g. semi-annual instead of quarterly). Any proposed reduction in monitoring frequency will be submitted to DOE for approval prior to implementation.

Additional hydraulic monitoring will be conducted during the first year of PTW operation. This additional hydraulic monitoring will consist of water level measurements collected on a monthly basis.

One routine monitoring event per year will be replaced by the annual monitoring event regularly conducted by WVES at the site. The annual monitoring event will include water level measurements and groundwater sampling of the full monitoring network, and laboratory analysis for Sr-90 and geochemical constituents.

Every five years a comprehensive monitoring event will be completed. The comprehensive monitoring event will replicate the initial baseline monitoring event and include more comprehensive hydraulic and groundwater monitoring as described in Section 6.5.

Additional details related to the identified monitoring events are included in the following sections. The monitoring schedule is summarized below. A summary of the performance monitoring activities associated with each monitoring event is included in Table 1.

Performance Monitoring Schedule

Monitoring Event	Frequency
Initial Baseline Monitoring	Completed once following PTW Installation.
Routine Monitoring[1]	Year 1 – Year 2: Quarterly Year 3 – Year 20: Potential reduced frequency depending on temporal variability of quarterly data collected in Year 1 – Year 2.
Supplemental Hydraulic Monitoring	Year 1: Monthly
Annual Monitoring[2]	Annually
Comprehensive 5-Year Monitoring	Once every five years

Notes:
1. Routine monitoring event replaced by annual monitoring event once per year.
2. Annual monitoring event replaced by comprehensive monitoring once every five years.

6.1 Initial Baseline Monitoring

The initial baseline monitoring will be a comprehensive baseline evaluation of hydraulics and groundwater chemistry in the PTW area and within the PTW itself. The baseline monitoring event will be conducted within three months of PTW installation and will consist of the following:

- Water level measurements – full network.
- In situ hydraulic conductivity testing – PTW wells.
- Well tracer dilution tests – Dilution tests for intra-wall wells located at Station 1, 3, 5, 9, and 11 (Figure 8a). The borehole dilution tests will provide additional information about groundwater flow velocities in the PTW. Stations 3, 5, and 9 are located in the three Sr-90 plume lobes (Figure 8a). Station 1 and Station 11 are located at the eastern and western ends of the PTW. Dilution tests will also be conducted for the five wells installed in the till hills to determine if these wells should be included in routine sampling events.
- Intra-wall hydraulic monitoring – Pressure transducer installation for a subset of intra-wall wells will occur during the baseline monitoring event. Transducers will be installed and monitored for intra-wall wells located at Station 3, Station 5, and Station 9 (Figure 8a). The transducers will remain in place for a period of one year to monitor hydraulic responses to rainfall events and snowmelt. Transducers will be temporarily removed during groundwater sampling events. Data will be downloaded at this time.
- Sr-90 sampling – full network.
- Geochemical sampling – full network.

6.2 Routine Monitoring

During the first two years of PTW operation, routine monitoring will be conducted on a quarterly basis. Routine monitoring during the first year will include the following activities:

- Water level measurements – PTW wells.
- Sr-90 sampling – PTW wells.
- Geochemical sampling – PTW wells.

Routine monitoring events occurring after the first year of performance monitoring will include the following activities:

- Water level measurements – PTW wells.
- Sr-90 sampling – PTW wells.

After the second year of monitoring a reduced monitoring frequency could potentially be proposed if monitoring data indicates temporal variability can be adequately captured using a reduced monitoring frequency (e.g. semi-annual instead of quarterly). Any proposed reduction in monitoring frequency will be submitted to DOE for approval prior to implementation.

6.3 Supplemental Hydraulic Monitoring

During the first year of PTW operation additional water level measurements will be collected from the full network on a monthly basis. Water level measurements will be used to evaluate changes in the groundwater flow field that could potentially be attributable to installation of the PTW. Pressure transducer data will be downloaded during the monthly gauging events.

6.4 Annual Monitoring

One routine monitoring event per year will be replaced with a more comprehensive annual monitoring event. The annual monitoring consist of the following activities:

- Water level measurements – full network
- Sr-90 sampling – full network.
- Geochemical sampling – full network.

6.5 5-Year Comprehensive Monitoring

Every five years the annual monitoring event will be replaced by a more comprehensive 5-year monitoring event. The comprehensive monitoring event will include all of the monitoring activities completed during the baseline evaluation with the exception of the pressure transducer study. The five year comprehensive event will also include a re-survey of performance monitoring wells situated with the PTW to account for potential elevation changes attributable to zeolite settling.

6.6 Supplemental Characterization

The results of groundwater monitoring and hydraulic evaluation tests will be used to evaluate the effectiveness of the PTW in meeting the related functional requirements (i.e., Functional Requirements 1-4). If the results of the monitoring program indicate actual or potential unacceptable performance, additional measures will be implemented to: (1) verify the performance issue, (2) quantify the performance concern; and, if necessary, (3) develop mitigation measures designed to return the PTW to acceptable performance. The following paragraphs provide additional discussion on this topic.

Verification of potential unintended performance will be the first step in developing an appropriate contingency mitigation approach. Potential deficiencies in performance may be indicated by the analytical results of one or more groundwater samples from one or more groundwater monitoring locations exceeding water quality goals for the specific location. Although water level information also could be used to assess functionality of the PTW, water chemistry will be the primary parameter used to evaluate PTW performance. In this case, verification of results that exceed goals (i.e. Sr-90 activity values that exceed acceptable levels) will be performed after a potential exceedance is determined to be valid by the laboratory (that is, following successful review of quality assurance/quality control results for the sample(s) in question). The verification will consist of resampling the subject well(s) and chemically analyzing the data according to approved site methodology. If the new result does not show an exceedance of the water quality goal, then additional actions may not be necessary. If additional actions are not completed, future results from the well(s) of concern will be closely evaluated in future monitoring events.

Additional assessment, including potential additional characterization, will be performed to quantify the potential performance concern if the resampling confirms the water quality value exceedance. The additional work may include the following activities: (1) reviewing as-built construction information for potential structural conditions that may have influenced the results: (2) sampling additional adjacent well(s) to comprehensively evaluate the dimensions of the potential performance issue; (3) performing hydraulic tests – tracer and/or stress tests – to evaluate the groundwater/analyte flow patterns in the vicinity of the performance issue; (4) performing intrusive evaluation – boring or additional well placement – to comprehensively evaluate the subsurface conditions in and adjacent to the PTW in the area of concern. The specific measures to be used in this quantification characterization will be written in a work plan developed at the time of need, and subject to review by the DOE prior to implementation.

The results of the quantification characterization activities will be used to determine whether corrective action is necessary. Corrective action could consist of changes in the monitoring regime (e.g. more frequent monitoring, modifying the sampling parameter list, installing additional wells) and/or construction-based corrections including: reconfiguring the PTW in the area of under-performance by removing a portion of the PTW and replacing it, or adding additional lengths of the PTW up- or down-gradient from the under performing PTW section. The under performing PTW section could be abandoned and isolated (e.g. by grout injection) if such action will not detrimentally impact the performance of the remaining PTW. Before any such intrusive corrective action is attempted, a comprehensive design will be developed, reviewed, and vetted through the WVES design review process.

All actions related to the contingency mitigation approach will refer back to the PTW design basis as a guide to potential performance issues. This includes referring to both the laboratory tests performed by University of Buffalo and the engineering drawings used as the design basis.

7.0 DATA ANALYSIS AND REPORTING

Results and data analysis generated from the performance monitoring program outlined in this Plan will be incorporated into existing annual groundwater reporting requirements for the site. Data analysis will include:

- Potentiometric surface maps – Water level measurements will be used to construct potentiometric surface maps. The potentiometric surface maps will be used to assess the movement of Sr-90 impacted groundwater in the vicinity of the PTW.
- Vertical gradient analysis – Water level measurements from well couplets and cluster wells will be used to assess vertical gradients between the TBU and SWS and the potential for vertical flow within the PTW.
- Sr-90 Plume Maps (plan view) – Maps depicting the lateral distribution of Sr-90 in the vicinity of the PTW will be developed from groundwater sampling results. Changes in the lateral distribution of Sr-90 will be used as one line of evidence to evaluate treatment of Sr-90 impacted groundwater.
- Sr-90 Plume Maps (cross section view) – Cross sections will be constructed from influent, intra-well, and effluent PTW wells. Comparison of Sr-90 distributions at influent, intra-wall, and effluent cross sections will be used as one line of evidence to evaluate treatment of Sr-90 impacted groundwater.
- Geochemical Parameter Distribution Maps (plan view) – Maps depicting the lateral distribution of geochemical constituents in the vicinity of the PTW will be developed from groundwater sampling results. Because sorption of Sr-90 to the zeolite structure displaces monovalent cations (potassium, sodium) changes in the lateral distribution of geochemical constituents will be used as a secondary line of evidence to evaluate treatment of Sr-90 impacted groundwater.
- Geochemical Parameter Distribution Maps (cross section view) – Cross sections will be constructed from influent, intra-well, and effluent PTW wells. Because sorption of Sr-90 to the zeolite structure displaces monovalent cations (potassium, sodium) comparison of geochemical signatures at influent, intra-wall, and effluent cross sections will be used as a secondary line of evidence to evaluate treatment of Sr-90 impacted groundwater.
- Hydraulic Testing Data Analysis – Data from slug tests, pressure transducers, and dilution tests will be analyzed to better understand the movement of Sr-90 impacted groundwater in the vicinity of the PTW.

A summary of the various types of data analysis identified in this Plan is included in Table 2.

8.0 REFERENCES

AMEC Geomatrix, Inc. (AMEC), 2009, West Valley 30% Design Report, North Plateau Permeable Treatment Wall, prepared for West Valley Environmental Services, LLC, October.

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Hall, S. H., 1993, Single-well tracer tests in aquifer characterization, Ground Water Monitoring and Remediation, 13:2, p. 118-124.

TABLE 1

PERFORMANCE MONITORING ACTIVITIES

North Plateau Permeable Treatment Wall
West Valley Environmental Services, LLC
West Valley, New York

	Initial Baseline Monitoring	Routine Monitoring (year 1)	Routine Monitoring (subsequent years)	Supplemental Hydraulic Monitoring (year 1)	Annual Monitoring	Comprehensive Monitoring (every 5 years)
Visual Inspections	x	x	x	x	x	x
Hydraulic Monitoring						
Water Level Measurements – PTW Wells		x	x	x	x	x
Water Level Gauging – Full Network	x			x	x	x
Slug Testing – PTW Wells	x					x
Well Tracer Dilution Tests	x					x
Pressure Transducer Tests[1]	x	x				
Groundwater Quality Monitoring						
Strontium-90 Sampling – PTW Wells		x	x			
Strontium-90 Sampling – Full Network	x				x	x
Geochemical Sampling[2] – PTW Wells		x				
Geochemical Sampling[2] – Full Network	x				x	x
Field Parameters[3]	x	x	x		x	x

Notes:

1. Pressure transducers will be installed in select monitoring wells during the first year of PTW operation to evaluate hydraulic effects of snowmelt and rainfall runoff.
2. Geochemical sampling will include sodium, potassium, calcium, magnesium, carbonate, bicarbonate, sulfate, and chloride.
3. Standard water quality measurements will be collected from each sampled well. Measurements will include temperature, pH, oxidation-reduction potential, specific conductance, dissolved oxygen, and turbidity.

TABLE 2

EVALUATION OF FUNCTIONAL REQUIREMENTS
North Plateau Permeable Treatment Wall
West Valley Environmental Services, LLC
West Valley, New York

Functional Requirement	Data Analysis
1. Create a sorption barrier (PTW) that limits the expansion of groundwater impacted by Sr-90 at or above the 10,000 pCi/L level. Due to constructability issues, the PTW will not be designed to address groundwater impacted at or above the 10,000 pCi/L level that has migrated below and west of the CDDL.	**Sr-90 Plume Map (plan view).** Maps depicting the lateral distribution of Sr-90 in the vicinity of the PTW will be developed from groundwater sampling results. Plume maps used to monitor changes in the spatial distribution of Sr-90 at or above the 10,000 pCi/L level.
	Sr-90 Plume Maps (cross section view) – Cross sections will be constructed from influent, intra-well, and effluent PTW wells. Sr-90 distribution at effluent cross section used to evaluate concentrations at the presumed PTW effluent.
2. Sr-90 contamination levels in groundwater passing through the PTW should demonstrate an overall stable or downward trend (compared to upgradient levels) over time to support an objective of substantially reducing plume expansion	**Sr-90 Plume Map (plan view).** Maps depicting the lateral distribution of Sr-90 in the vicinity of the PTW will be developed from groundwater sampling results. Changes in the lateral distribution of Sr-90 will be used as one line of evidence to evaluate treatment of Sr-90 impacted groundwater.
	Sr-90 Plume Map (cross section view). Cross sections will be constructed from influent, intra-well, and effluent PTW wells. Comparison of Sr-90 distributions at influent, intra-wall, and effluent cross sections will be used as one line of evidence to evaluate treatment of Sr-90 impacted groundwater.
	Geochemical Parameter Distribution Maps (plan view) – Maps depicting the lateral distribution of geochemical constituents in the vicinity of the PTW will be developed from groundwater sampling results. Because sorption of Sr-90 to the zeolite structure displaces monovalent cations (potassium, sodium) changes in the lateral distribution of geochemical constituents can be used as a secondary line of evidence to evaluate treatment of Sr-90 impacted groundwater.

TABLE 2

EVALUATION OF FUNCTIONAL REQUIREMENTS
North Plateau Permeable Treatment Wall
West Valley Environmental Services, LLC
West Valley, New York

Functional Requirement	Data Analysis
	Geochemical Parameter Distribution Maps (cross section view) – Cross sections will be constructed from influent, intra-well, and effluent PTW wells. Because sorption of Sr-90 to the zeolite structure displaces monovalent cations (potassium, sodium) comparison of geochemical signatures at influent, intra-wall, and effluent cross sections can be used as a secondary line of evidence to evaluate treatment of Sr-90 impacted groundwater.
3. Sr-90 contamination should not be redirected to currently less-contaminated areas.	**Sr-90 Plume Maps (plan view)** – Maps depicting the lateral distribution of Sr-90 in the vicinity of the PTW will be developed from groundwater sampling results. Changes in the lateral distribution of Sr-90 will be used as one line of evidence to assess the potential redirection of Sr-90 impacted groundwater to less contaminated areas.
	Potentiometric surface maps – Water level measurements will be used to construct potentiometric surface maps. The potentiometric surface maps will be used to assess the movement of Sr-90 impacted groundwater in the vicinity of the PTW.
	Hydraulic Testing Data Analysis – Data from slug tests, pressure transducers, and dilution tests will be analyzed to better understand the movement of Sr-90 impacted groundwater in the vicinity of the PTW.
4. Groundwater flow through the PTW should be sufficient to preclude substantial changes in groundwater flow patterns that would require additional mitigation actions.	**Potentiometric surface maps** – Water level measurements will be used to construct potentiometric surface maps. The potentiometric surface maps will be used to assess the movement of groundwater in the vicinity of the PTW.
	Hydraulic Testing Data Analysis – Data from slug tests, pressure transducers, and dilution tests will be analyzed to better understand the movement of groundwater in the vicinity of the PTW.

Figure 1
Site Location

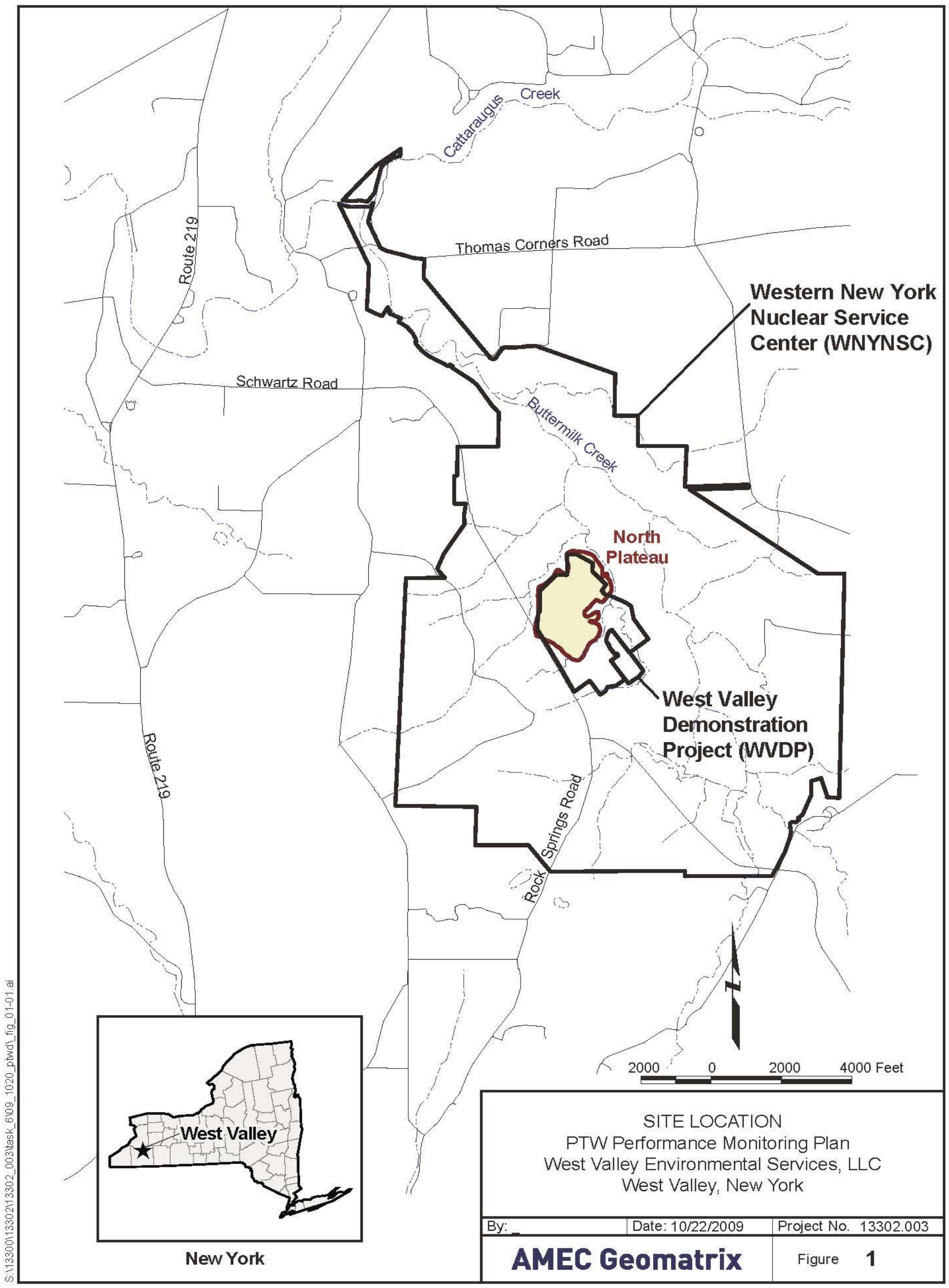


Figure 2
Site Features

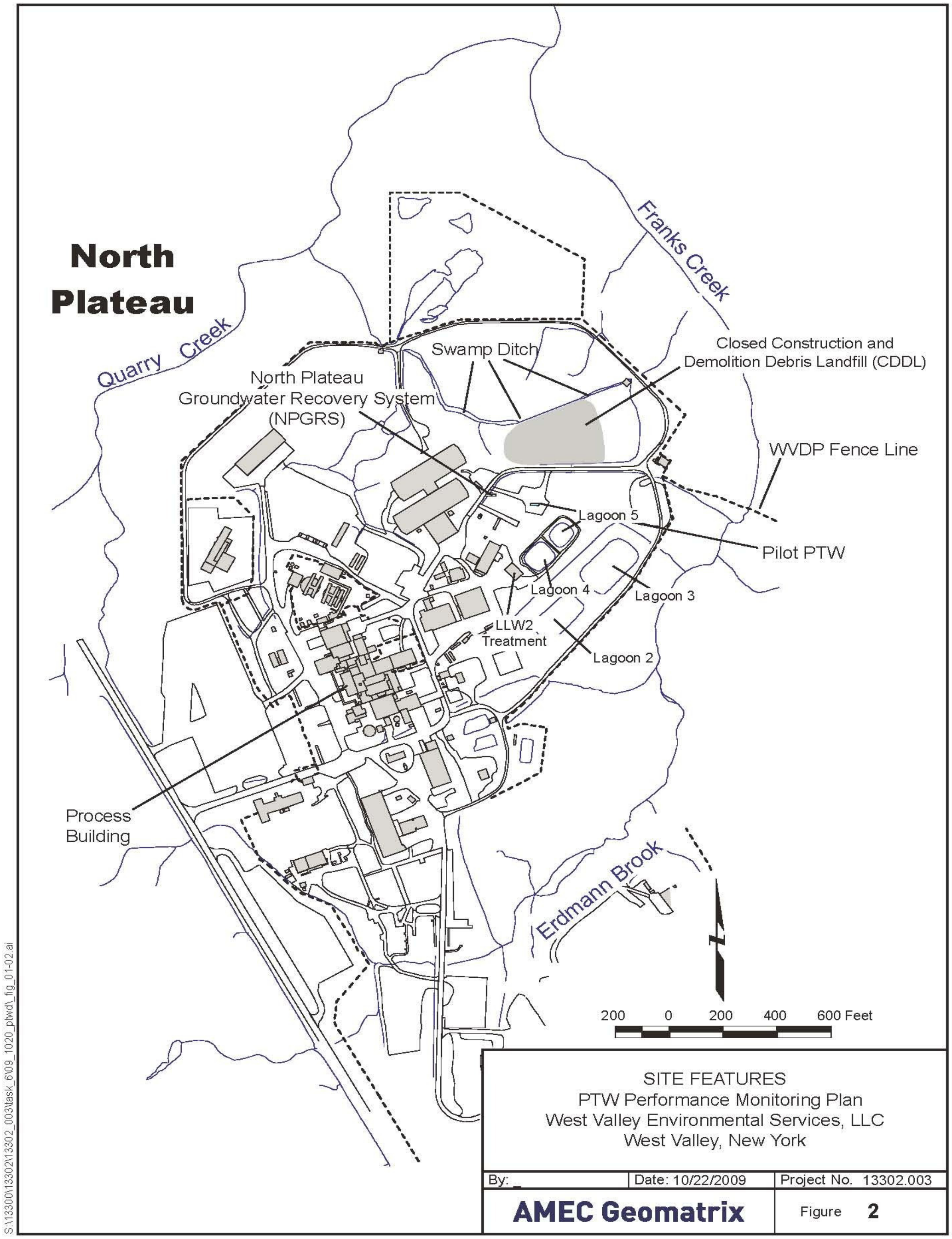


Figure 3
Distribution of Sr-90 in Sand and Gravel Unit

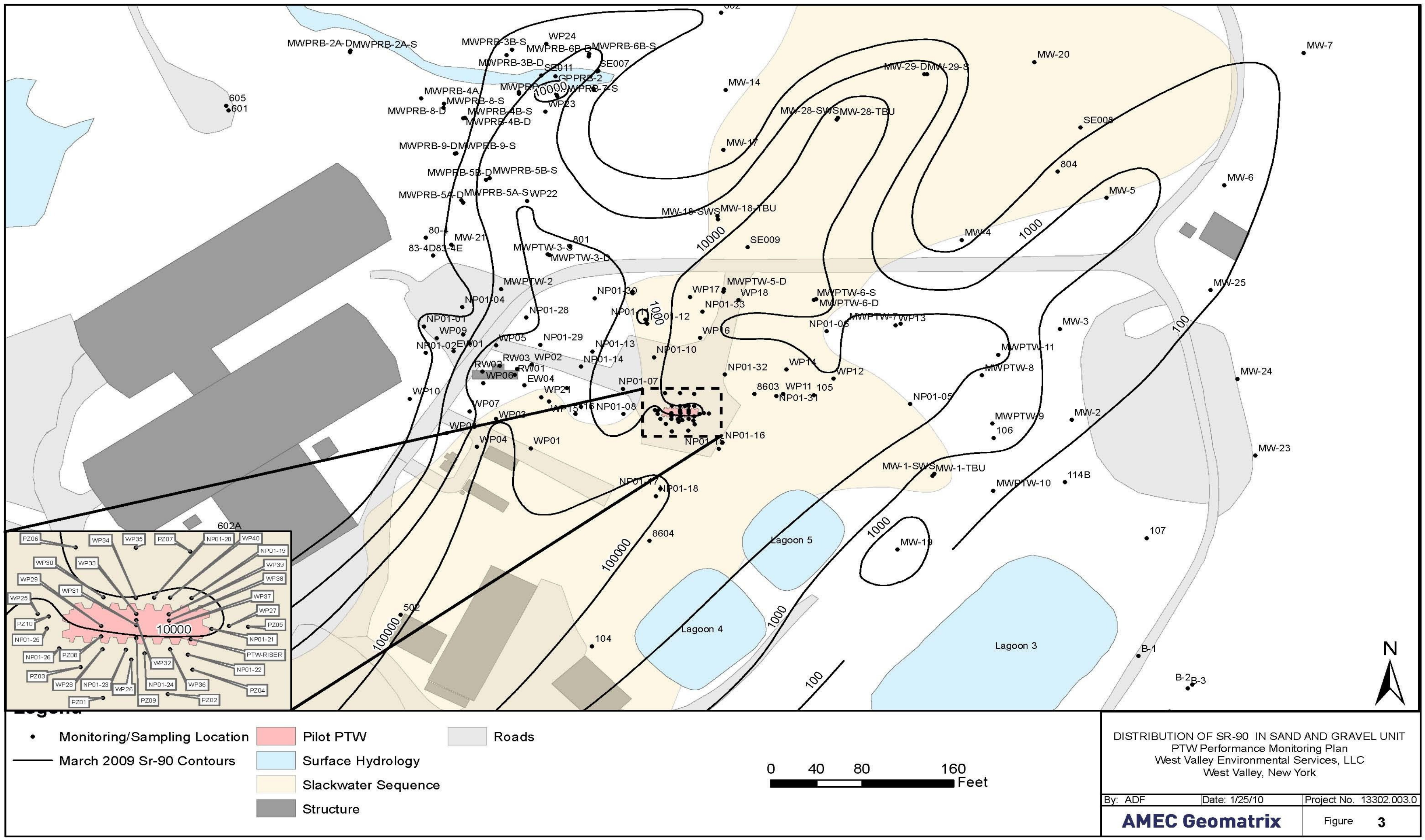


Figure 4
PTW Alignment

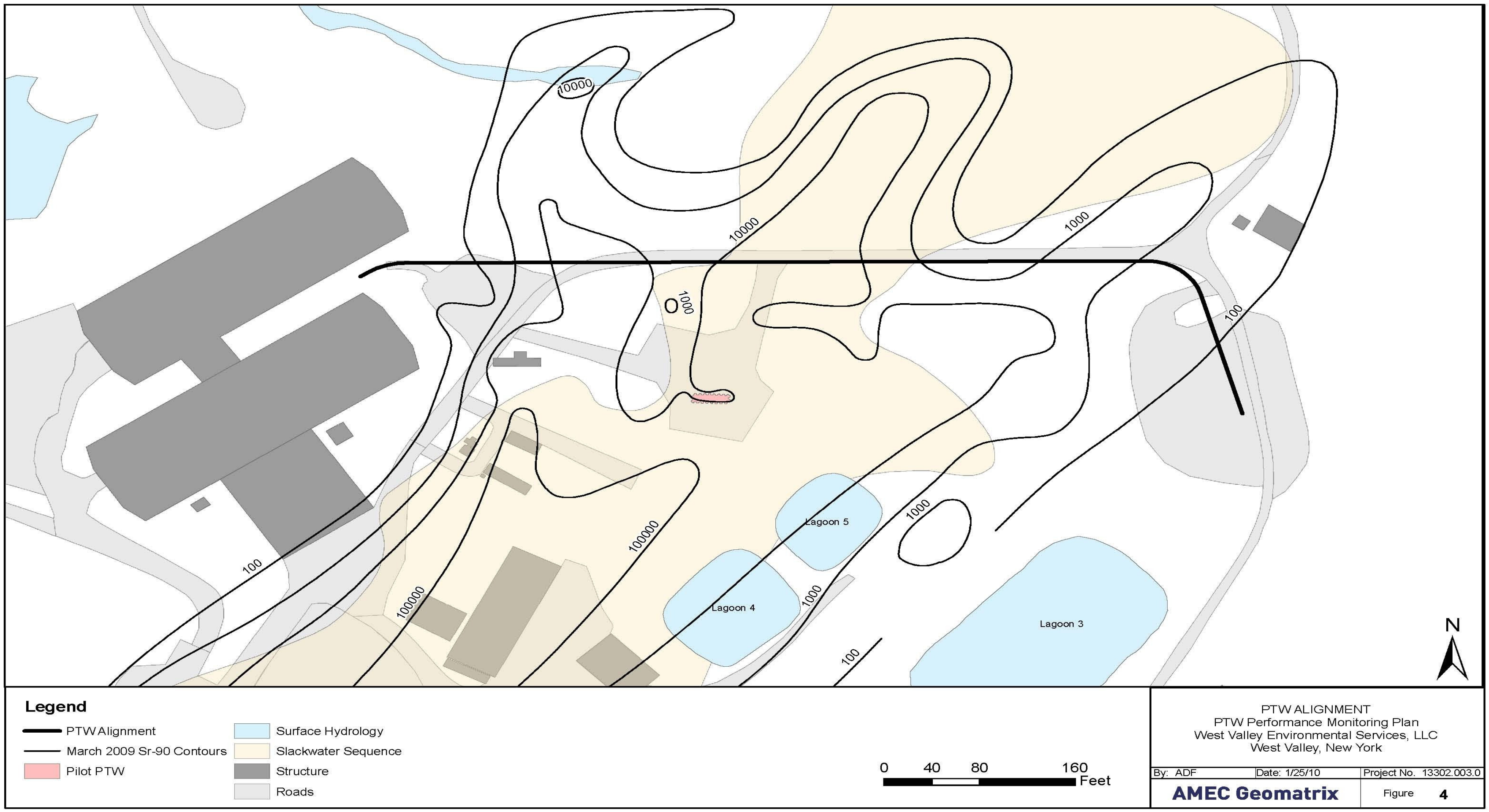


Figure 5
February 2010 Soil Boring Locations

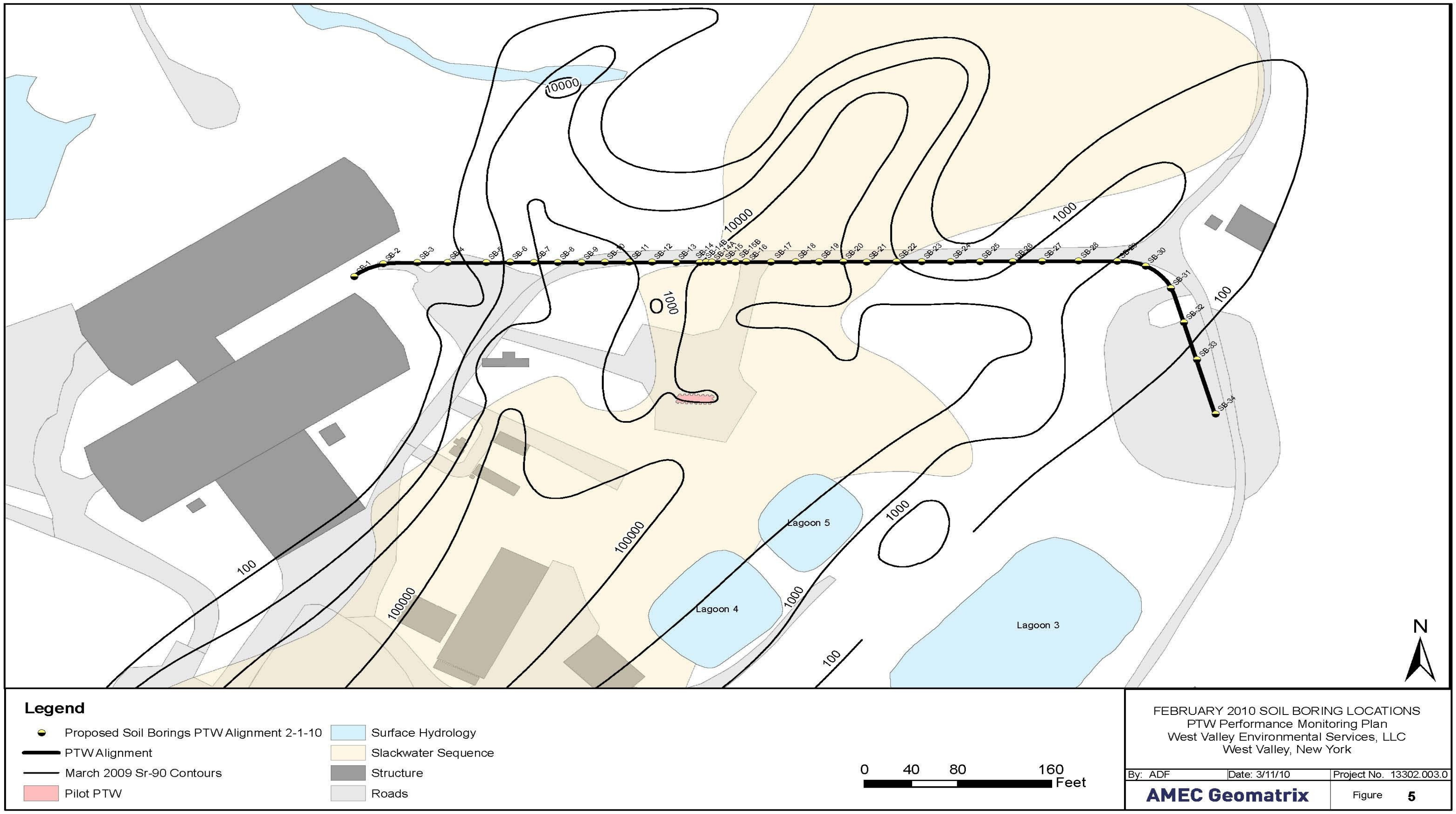
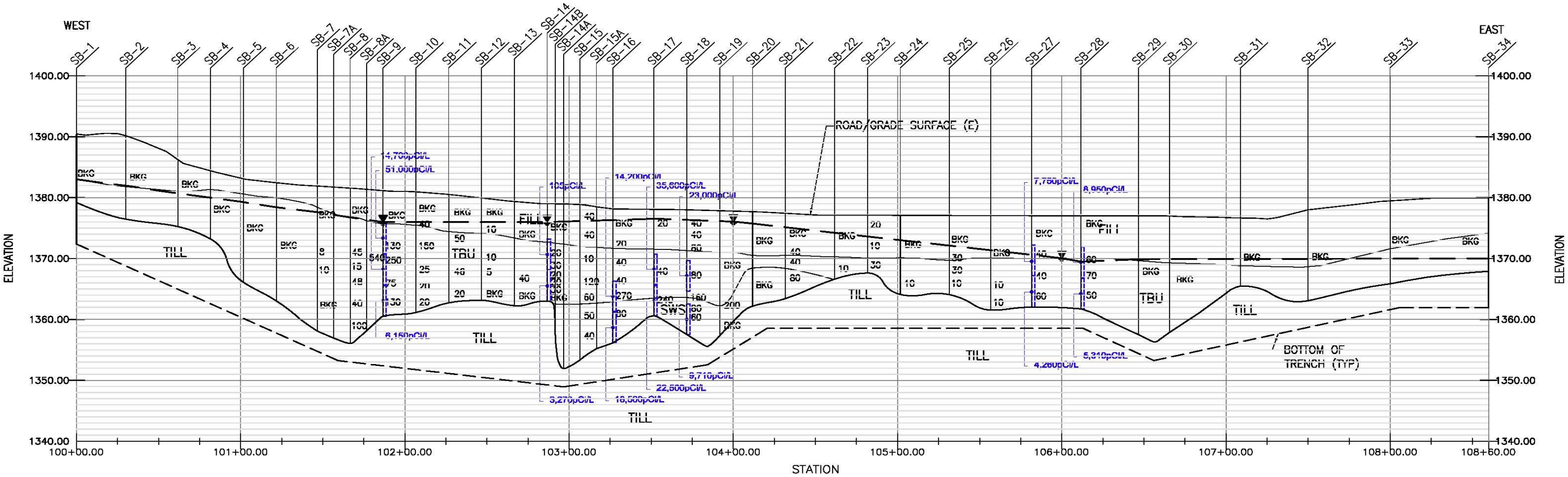


Figure 6
February 2010 Investigation Results



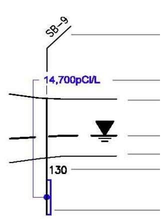
Horizontal Scale 1"=60'
Vertical Scale 1"= 12.5'
Vertical exaggeration = 4x

EXPLANATION

SWS = Slackwater sequence
TBU = Thick bedded unit

NOTES:

1. Geoprobe borings completed along the PTW alignment in February 2010.
2. Sr-90 groundwater sample analyzed at the WVDP on-site laboratory using the Empore method.



Boring ID
Depth discrete groundwater sample, Sr-90 activity
Ground surface
February 2010 groundwater level
Geologic unit contact
Geiger Muller (GM) radioactivity readings above background in soil reported by WVES rad tech. (BKG = background)
Temporary well screens where samples were collected
Screen depth = 4'

FEBRUARY 2010 INVESTIGATION RESULTS PTW Performance Monitoring Plan North Plateau Permeable Treatment Wall West Valley Environmental Services, LLC West Valley, New York		
By: AF	Date: 03/15/10	Project No. 13302.000
AMEC Geomatrix		Figure 6

Plot Date: 03/15/10 - 1:32pm, Plotted by: irena.stolnik
Drawing Path: S:\13300\13302\13302_003\task_509_0701_ptwt\FIGURES\, Drawing Name: _fig_cs.dwg

Figure 7
Existing North Plateau Monitoring Network

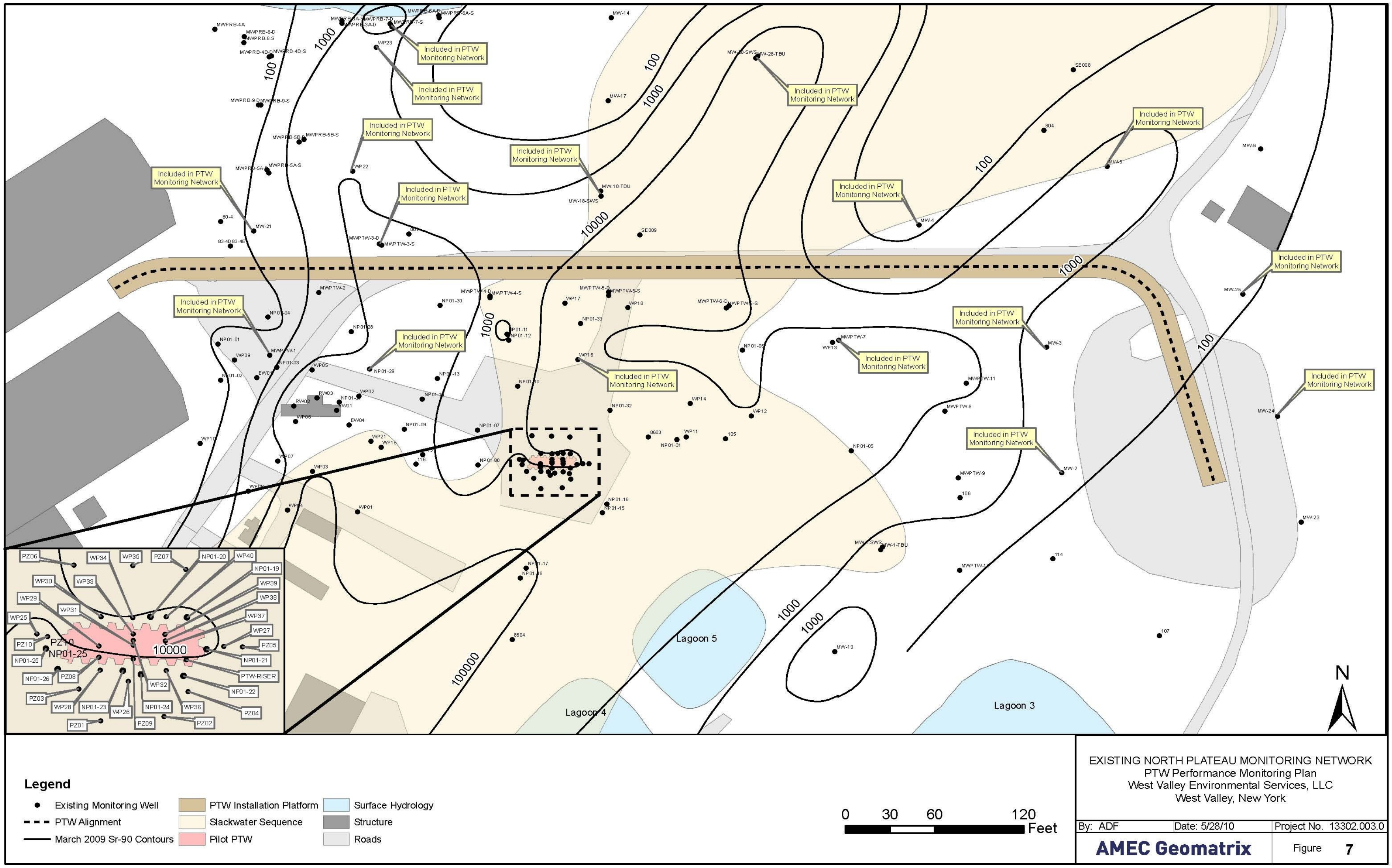


Figure 8a
Performance Monitoring Network

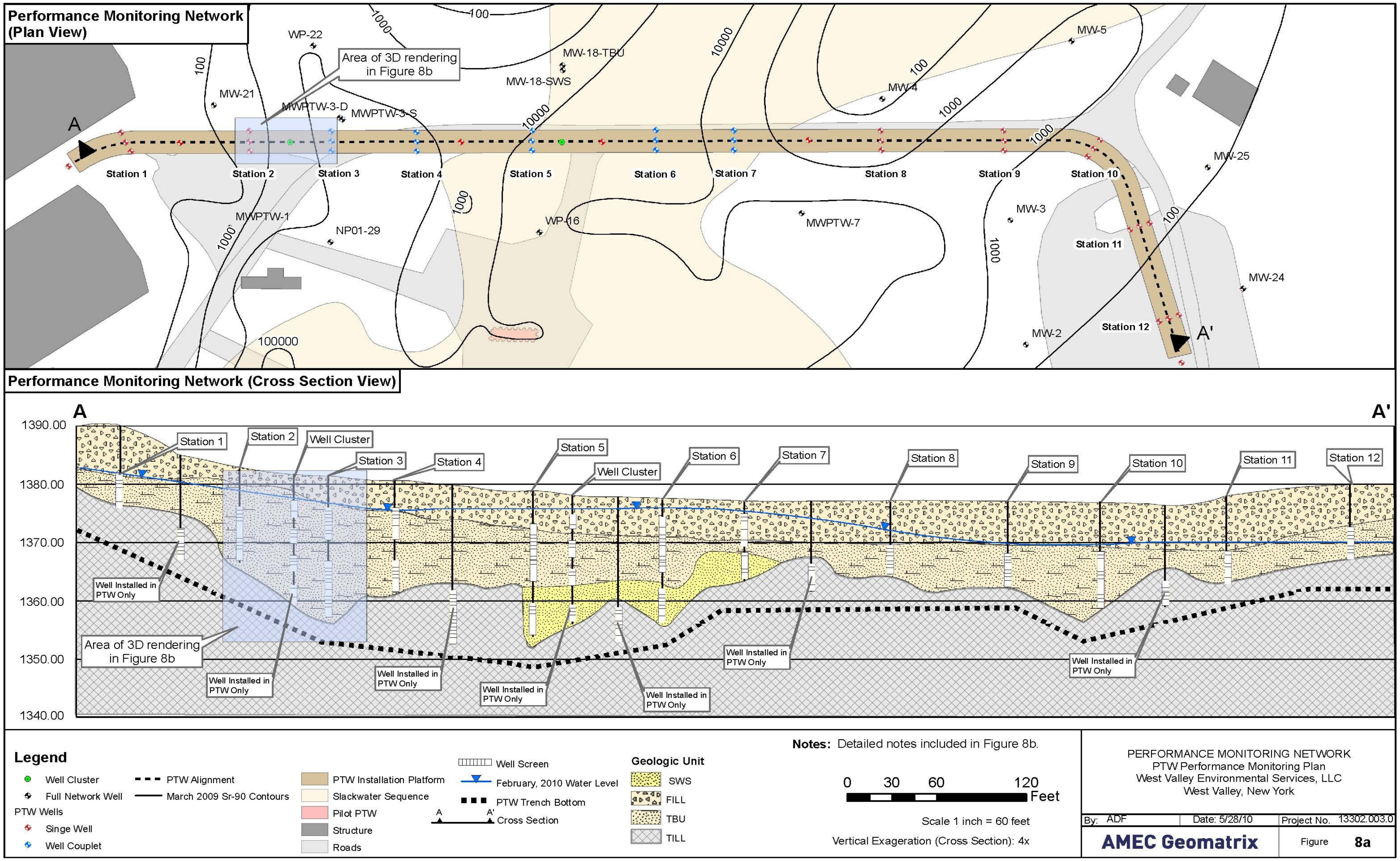


Figure 8b
Performance Monitoring Network

Conceptual 3D Rendering
Performance Monitoring Well Network

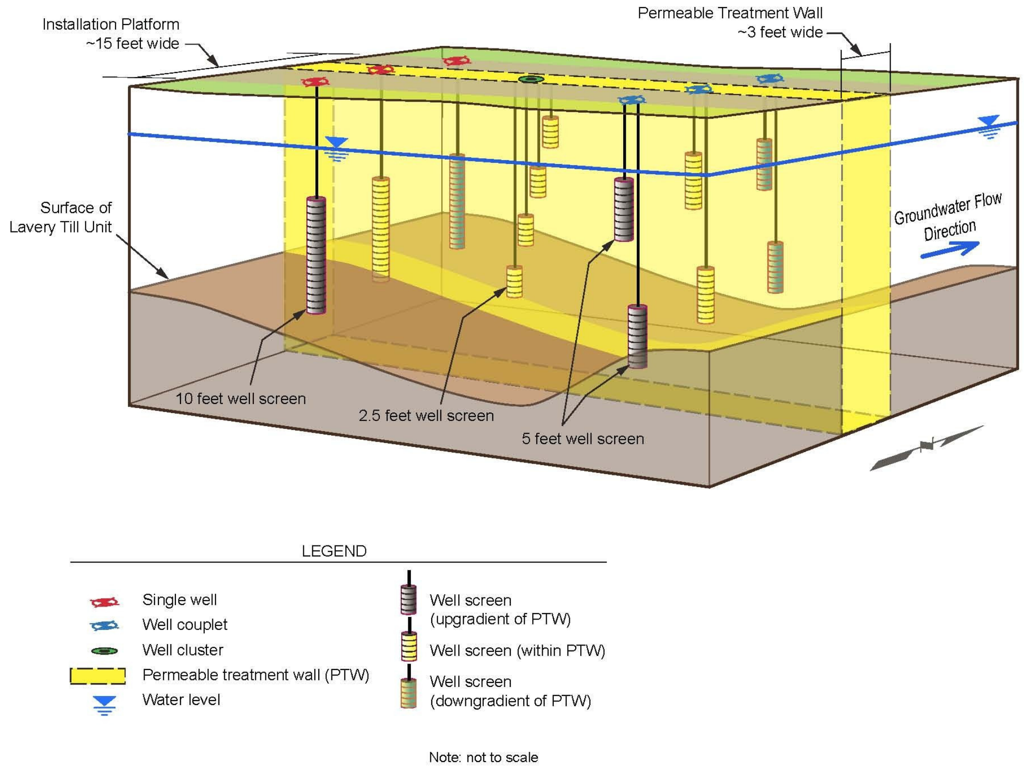


Figure Notes/Explanation

Plan View Notes

1. Well couplets and well clusters are depicted as a single location in plan view for clarity. Well couplets and well clusters will be installed as separate, collocated wells.
2. Extent of slackwater sequence has been updated from previous reports based on results from the February 2010 soil boring program.

Cross Section Notes

SWS = Slackwater sequence

TBU = Thick Bedded Unit

1. Extent of geologic units is based on February 2010 soil boring program.
2. Water table elevation is based on February 2010 soil boring program.
3. Well couplets and well clusters are depicted as separate well screens on a single black line for clarity. Well couplets and well clusters will be installed as separate, collocated wells.
4. Unless otherwise noted, monitoring stations will be installed as a transect of three monitoring locations oriented perpendicular to the PTW (see plan view figure). Each monitoring station will include a monitoring location upgradient, within, and downgradient of the PTW. Only one of the three monitoring locations for each station is shown in cross section view for clarity.

3D Rendering Notes

1. Groundwater flow direction is approximate.
2. Water table elevation is approximate.

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PERFORMANCE MONITORING NETWORK
PTW Performance Monitoring Plan
West Valley Environmental Services
West Valley, New York

By: ADF	Date: 01/25/2010	Project No. 13302.003
AMEC Geomatrix		Figure 8b

ATTACHMENT - A
EXAMPLE PTW INSPECTION FORM
North Plateau Permeable Treatment Wall

Date: ______________________ Weather: ______________________
Inspection By: ______________________ Time In: ______________________
Others On Site: ______________________ Time Out: ______________________

Visual Observations – PTW Platform:

	YES	NO	Comments	Corrective Action Required (Y/N)
Improper drainage or excessive ponding?				
Subsidence, rutting, or excessive erosion?				
Excessive vegetation/overgrowth observed?				
New construction/infrastructure observed in vicinity of PTW?				
New landscaping observed in vicinity of PTW?				

If maintenance is required to resolve any of the above noted items, describe what actions taken, if any. Were all maintenance items resolved during this site visit? If no, what items remain to be resolved?

____

____

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Visual Observations – Stormwater Infrastructure:

	YES	NO	Comments	Corrective Action Required (Y/N)
Debris accumulation in drainage channels?				
Damage to drainage channel liner?				
Debris accumulation at catch basin inlets?				

If maintenance is required to resolve any of the above noted items, describe what actions taken, if any. Were all maintenance items resolved during this site visit? If no, what items remain to be resolved?

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Note: This form is provided as an example template only and should be modified and updated as needed to reflect current project conditions.

WVDP RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue	All	08/26/10
	EA, QA are affected by this issue.		